GWOU ADMINISTRATIVE RECORD
SECTION TITLE:
GW-300-304-1.03

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MAR 2 3 2001

Mr. Dan Wall
Project Manager
Federal Facilities/Special Emphasis Branch
Superfund Division
U.S. Environmental Protection Agency Region VII
901 N. 5th Street
Kansas City, KS 66101

Dear Mr. Wall:

IN SITU CHEMICAL OXIDATION 30/60% DESIGN SPECIFICATIONS

Enclosed is the subject design package. At this stage there are numerous gaps and some unnecessary boilerplate specifications. This information is being sent primarily to keep you and MDNR up to date on our design progress. We do not have a specified time period set aside for your review and comment, but if you have any comments, please call me and we will attempt to address them during the design process.

Sincerely,

Thomas C. Pauling
Environmental Engineer

Enclosure:
As stated

cc w/enclosure:
Branden Doster, MDNR
Ben Moore, MDNR

EM-95:Jenright:7051:bdh:03/23/01:(m:In Situ Chemical.doc)

ENGINEERING

FILE NUMBER

12-06-568

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

U.S. DEPARTMENT OF ENERGY
CONTRACT NO: DE-AC05-86OR21548
WELDON SPRING SITE REMEDIAL ACTION PROJECT

DESIGN DOCUMENT REVIEW REQUEST
(Request for Review by the Design Review Board)

TO BE COMPLETED BY THE REQUESTING ENGINEER

Review No:

Work Package Number: 568

Date: 08/15/01

Work Package Title: **IN SITU CHEMICAL OXIDATIO NOF TCE IN GROUNDWATER**

Subject (Purpose of Review):

Return review comments by:	Design Review: [] Document Review: [X]	Site Originated: X Off-Site Originated: []	Quality Assurance Level 2

Requestor: **JOE KAZEMI**

Title: **PROJECT ENGINEER**

Design Document Number(s):

PLESE REVIEW THE ENCLOSED DOCUMENT WP568 IN SITU CHEMICAL OXIDATION OF TCE IN GROUNDWATER
BY COB AUGUST 16, 2001.

Reference Documents:

Distribution:

DISTRIBUTION

W/ATTACHMENTS

Design Review Board

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DOE PROJECT ENG.

THIS REQUEST HAS BEEN REVIEWED AND APPROVED BY THE ENGINEERING MANAGER

Signature: Joe Kazemi

Date: 8/15/01

Morrison Knudsen Corporation
Engineering, Construction & Environmental Group

WSSRA PROJECT REVIEWS AND APPROVALS

W.P. NO. 568 TASK NO. 541GW.900 DOC. NO. 3840-C:HG-S-05-4864-0A

W.P. TITLE: In Situ Chemical Oxidation of TCE in Groundwater

QUALITY LEVEL 2

LEAD DISCIPLINE Hydrogeology

SUBJECT: WSSRAP – Chemical Plant
Technical Specifications Section 01503
Equipment Decontamination
Issued for Review
Revision A

	PRINT/TYPE NAME	SIGNATURE	DATE
PREPARED:	K. Ohsiek		
REVIEWED:	P. Patchin		
APPROVED MKES:			
- LEAD TASK ENGINEER	P. Patchin		
- LEAD DISCIPLINE DEPT. MGR.	S. Vincent		
- DESIGN MANAGER	R. Rager		
- ENGINEERING MANAGER	R. Bohachek		
APPROVED:			
- OFF-SITE QUALITY MANAGER			

SECTION 01503

EQUIPMENT DECONTAMINATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Specification Section describes the requirements and procedures for equipment decontamination.

B. Equipment to be decontaminated includes drilling equipment, chemical injection equipment, and other contaminated equipment prior to leaving the site.

1.02 RELATED SECTIONS

A. Section 01300 – Submittals

B. Section 02050 – In Situ Chemical Oxidation

C. Section 02733 – Well Installation

1.03 SUBMITTALS

A. The Subcontractor shall prepare an Equipment Decontamination Plan for Contractor review and approval. The plan shall describe the materials and construction of the temporary decontamination facility, which the Subcontractor shall use for equipment decontamination. The plan shall also describe the decontamination procedures to be followed and the dismantlement of the facility. Sketches, plans, and other information shall be included as appropriate.

1.04 SUBMITTAL SCHEDULE

The following submittal is required in accordance with this specification.

Specification Reference	Requirements	Period
01503 (1.03.A)	Equipment Decontamination Plan	30 days prior to work

1.05 PROJECT SITE CONDITIONS

A. The areas of the site where the work will be performed are at final grade, and temporary vegetation has been established.

B. TCE is the major contaminant of concern in groundwater beneath the site although tetrachloroethylene (PCE), dichloroethylene (DCE), uranium, nitroaromatic compounds, and nitrate have also been identified

C. A staging area near Gate G (see Section 01500 Figure 1) shall be used by the Subcontractor for the construction of a temporary decontamination facility.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.01 PREPARATION

A. All equipment or materials that will come into contact with subsurface materials shall be decontaminated or certified clean prior to bringing on site.

B. Contamination of equipment shall be minimized to the extent practical through barriers, engineering controls, and administrative controls.

C. All contaminated equipment shall be decontaminated at a Subcontractor-furnished decontamination facility located at the staging area near Gate G. The pad shall be constructed in accordance with the approved Equipment Decontamination Plan and shall be constructed entirely above ground.

3.02 DECONTAMINATION

A. All contaminated material removed from equipment shall be contained and controlled. The spread of contamination shall be prevented.

B. Waste generation shall be minimized.

C. All contamination shall be handled and disposed in accordance with the requirements of the HASP.

D. Decontamination water shall constitute a contaminated wastewater stream and shall be handled in accordance with the approved Work Plan and Section 01600.

END OF SECTION 01503

Morrison Knudsen Corporation
Engineering, Construction & Environmental Group

WSSRA PROJECT REVIEWS AND APPROVALS

W.P. NO. 568 TASK NO. 541GW.900 DOC. NO. 3840-C:EN-S-05-4865-0A

W.P. TITLE: In Situ Chemical Oxidation of TCE in Groundwater

QUALITY LEVEL 2

LEAD DISCIPLINE Civil

SUBJECT: WSSRAP – Chemical Plant
Technical Specifications Section 01600
Material Storage and Handling
Issued for Review
Revision A

	PRINT/TYPE NAME	SIGNATURE	DATE
PREPARED:	K. Ohsiek		
REVIEWED:	P. Patchin		
APPROVED MKES:			
- LEAD TASK ENGINEER	P. Patchin		
- LEAD DISCIPLINE DEPT. MGR.	K. Ohsiek		
- DESIGN MANAGER	R. Rager		
- ENGINEERING MANAGER	R. Bohachek		
APPROVED:			
- OFF-SITE QUALITY MANAGER			

SECTION 01600

MATERIAL STORAGE AND HANDLING

PART 1 - GENERAL

1.01 SCOPE

A. This Specification Section describes the requirements for material storage, protection, handling, transportation, and disposal.

B. Materials addressed by this Section include all chemicals, reagents, oxidants, and other hazardous or potentially hazardous materials furnished by the Subcontractor or created during execution of the Work.

1.02 RELATED SECTIONS

A. Section 01300 – Submittals

B. Section 01503 – Equipment Decontamination

C. Section 02050 – In Situ Chemical Oxidation

D. Section 02733 – Well Installations

1.03 SUBMITTALS

A. The Subcontractor shall submit:

1. Material Safety Data Sheet (MSDS) for each chemical, reagent, oxidant, and other hazardous material prior to bringing on site and shall be the latest available version.

2. Supplier or manufacturer requirements and recommendations for material storage, handling, protection, and transportation for each chemical, reagent, oxidant, and other potentially hazardous material brought on site.

1.04 SUBMITTAL SCHEDULE

A. The following submittals are required in accordance with this specification.

Specification Reference	Requirements	Period
01600 (1.03.A.1)	Most current Material Safety Data Sheet (MSDS) for each chemical, reagent, oxidant, and other hazardous material brought on site	5 days prior to bringing material on site
01600 (1.03.A.2)	Supplier or manufacturer requirements and recommendations for material storage, handling, protection, and transportation for each chemical, reagent, oxidant, and other potentially hazardous material brought on site	5 days prior to bringing material on site

1.05 PROJECT SITE CONDITIONS

A. The areas of the site where the work will be performed are at final grade and temporary vegetation has been established. Trichloroethene (TCE) is present in certain locations in the shallow groundwater. Other contaminants known to be present in the groundwater include dichloroethylene (DCE), tetrachloroethylene (PCE), uranium, nitroaromatics, and nitrate.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.01 GENERAL

A. All materials shall be stored, protected, transported, handled, and disposed in accordance with applicable local, state, and federal rules and regulations.

B. The Subcontractor shall provide trained labor and the proper equipment (in good working order) to load, unload and transport all materials.

C. If the Subcontractor during execution of the Work encounters any unexpected hazardous or potentially hazardous material, chemical, or contaminant, the Contractor shall be notified immediately.

3.02 STORAGE, PROTECTION, AND HANDLING

A. All materials shall be stored, protected, and handled in accordance with the requirements and recommendations of the material supplier and/or manufacturer.

B. Volumes of chemicals stored at the site for the purpose of treatment shall be limited to the amount necessary to perform that phase of treatment.

C. All materials shall be stored, protected, and handled in accordance with the requirements of the WSSRAP Health and Safety Plan (HASP). Chemicals may not be stored in the office trailer.

D. The Subcontractor is responsible for freeze protection for chemicals, hazardous materials, and solutions, as well as stored water awaiting reagent-neutralization treatment by the Subcontractor and subsequent treatment by the Contractor.

E. All necessary and appropriate enclosures, security, barricades, and other measures for proper material storage, protection, and handling shall be furnished and provided by the Subcontractor.

F. The Subcontractor shall maintain and submit to the Contractor an inventory of all on-site chemicals, hazardous materials, potentially hazardous materials, potentially contaminated drilling cuttings and fluids, potentially contaminated groundwater, and other materials associated with the Work. All such materials shall be kept separate and shall not be consolidated, combined, or mixed without prior approval by the Contractor.

3.03 GROUNDWATER

A. Groundwater brought to the ground surface by drilling, well development, sampling, or other activities shall be considered and handled as potentially contaminated material until the Contractor has determined the groundwater is not contaminated. The Subcontractor shall prevent the spread of potentially contaminated groundwater onto the ground surface and shall capture and collect all groundwater brought to the ground surface. The collected groundwater shall be protected from precipitation.

B. The Subcontractor shall limit the quantity of groundwater brought to the ground surface to the minimum necessary to execute the Work.

C. The Subcontractor shall treat all collected groundwater that is characterized as containing residual oxidation reagent. The Contractor will treat all collected groundwater that is characterized as RCRA hazardous or exceeds the site's NPDES permit limitations for any parameter (see Special Conditions for NPDES permit limitations) after the Subcontractor has treated it for residual reagent.

D. Purge water from wells where previous sampling shows TCE concentrations greater than 300 µg/l shall be handled as RCRA waste. Purge water from wells with no previous sampling data shall be handled as RCRA waste if wells in the immediate vicinity show TCE concentrations greater than 300 µg/l until sampling shows otherwise. The Subcontractor shall mark any containers used to transport this water

to the treatment area as "RCRA Purge Water." All such water will be pretreated to less than 100 µg/l TCE by the Contractor prior to being transferred to a storage tank containing other contaminated groundwater.

E. The Subcontractor shall notify the Contractor when a storage tank has been filled. The Contractor will have 10 calendar days after notification to transfer the water to the Contractor's water treatment area for further treatment and discharge.

3.04 DECONTAMINATION WATER

A. Water generated by decontamination activities shall be considered and handled as potentially contaminated material. The Subcontractor shall collect and store decontamination water. The Subcontractor shall treat the decontamination water for residual oxidation reagent.

B. The Subcontractor shall identify in the Work Plan all contaminants that may be present in the decontamination water from the residual oxidation reagent and have the potential to enter the effluent stream so that the Contractor can provide a 30-day notice to the State.

C. Disposition of treated decontamination water shall be addressed as described in part 3.03 E.

3.05 OTHER CONTAMINATED WASTES

A. All contaminated soil wastes generated by chemical spills, leaks, or other releases shall be handled in accordance with applicable RCRA regulations. The Subcontractor shall clean up, neutralize if necessary, and containerize all spill residues in clean, Subcontractor-provided, compatible containers. All soil wastes generated at the site shall be considered radioactive (?) The Subcontractor shall label and store the containers in accordance with RCRA regulations at the staging area near Gate G to await characterization by the Contractor.

B. The Subcontractor shall handle all contaminated solid waste generated as a byproduct of the residual reagent treatment process in accordance with applicable RCRA regulations. The Subcontractor shall containerize all such wastes in clean, Subcontractor-provided, compatible containers. The Subcontractor shall label and store the containers in accordance with RCRA regulations at the staging area near Gate G to await characterization by the Contractor.

C. The Contractor will be responsible for characterizing the containerized contaminated wastes and determining their ultimate disposition. The Subcontractor shall be responsible for the cost of sampling, testing, shipping, treatment, and/or disposal of the wastes (see Special Conditions for cost details).

3.06 DISPOSAL

A. The Contractor may direct the Subcontractor to dispose of certain contaminated materials. The Subcontractor shall not dispose of any materials without prior authorization from and close supervision by the Contractor. All disposal activities shall be in strict accordance with the procedures and requirements of the Contractor.

B. All excess chemicals, reagents, oxidants, and other hazardous or potentially hazardous originally brought on site by the Subcontractor shall be removed from the site by the Subcontractor and disposed of off-site in accordance with all local, state, and federal rules and regulations.

C. The Contractor will accept up to 1,500 gal/week of water from the Subcontractor. Any amount in addition to this may be accepted, subject to Contractor approval, at the Subcontractor's cost (see Special Conditions for cost details).

END OF SECTION 01600

Morrison Knudsen Corporation
Engineering, Construction & Environmental Group

WSSRA PROJECT REVIEWS AND APPROVALS

W.P. NO. 568 TASK NO. 541GW.900 DOC. NO. 3840-C:HG-S-05-4866-0A

W.P. TITLE: In Situ Chemical Oxidation of TCE in Groundwater

QUALITY LEVEL 2

LEAD DISCIPLINE Hydrogeology

SUBJECT: WSSRAP – Chemical Plant
Technical Specifications Section 02050
In Situ Chemical Oxidation

Issued for Review
Revision A

	PRINT/TYPE NAME	SIGNATURE	DATE
PREPARED:	K. Ohsiek		
REVIEWED:	P. Patchin		
APPROVED MKES:			
- LEAD TASK ENGINEER	P. Patchin		
- LEAD DISCIPLINE DEPT. MGR.	S. Vincent		
- DESIGN MANAGER	R. Rager		
- ENGINEERING MANAGER	R. Bohachek		
APPROVED:			
- OFF-SITE QUALITY MANAGER			

SECTION 02050

IN SITU CHEMICAL OXIDATION

PART 1 - GENERAL

1.01 SCOPE

A. In situ chemical oxidation treatment of groundwater at the WSSRAP Chemical Plant for dissolved TCE contamination shall be performed in two phases. The first phase is the pilot-scale testing of the treatment technology. The design of this testing phase will incorporate results from the previously performed bench-scale testing and apply them under actual field conditions. The testing shall be performed in a limited part of the TCE-impacted area of the site. The second phase is the full-scale application of the in situ chemical oxidation technology to the entire TCE-impacted area. The second phase shall only be implemented if the Contractor exercises the option.

B. This Specification Section describes the requirements for in situ chemical oxidation, (i.e., treatment) of trichloroethene (TCE) in groundwater at the Chemical Plant site to achieve the remedial goal of 5 ppb (µg/L) TCE, including:

1. Pilot-scale treatment system design
2. Pilot-scale testing of treatment concept
3. Full-scale treatment system design
4. Full-scale treatment system installation
5. Full-scale treatment system operation and maintenance
6. Groundwater monitoring and testing during and after treatment to evaluate progress of in situ oxidation of TCE in groundwater

1.02 RELATED WORK

A. Section 01300 – Submittals

B. Section 01503 – Equipment Decontamination

C. Section 01600 – Material Storage and Handling

D. Section 02733 – Well Installation

1.03 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by the basic designation only:

1. Missouri CSR – Code of State Regulations

   10 CSR 23 – Missouri Well Construction Rules

   10 CSR 50 – Underground Injection Control Rules

2. MDNR – Missouri Department of Natural Resources

   Missouri Well Construction Rules. Authorizing Statutes – 256.600 to 256.640 RSMo, Division of Geology and Land Survey, Rolla, Missouri.

3. National Electric Code

1.04 DEFINITIONS

A. DOE: U.S. Department of Energy

B. TCE: Trichloroethene

C. DCE: Dichloroethylene

D. PCE: Tetrachloroethylene

E. Treatment system: All necessary well installation(s), field instrumentation, electrical systems, temporary facilities, piping systems, and appurtenances necessary for the introduction of reagent(s) into and/or transport of potentially contaminated groundwater.

F. PPE: Personal protective equipment

G. ppb: Parts per billion

H. µg/L: Micrograms per liter (10^{-6} grams per liter)

I. MCL: Maximum contaminant level

J. SAP: Sampling and Analysis Plan

1.05 PROTECTION

A. The Subcontractor shall protect the following:

1. Benchmarks and monuments

2. Existing structures and fences

3. Monitoring wells

4. All areas outside of immediate work area

5. Existing features not part of this Work

1.06 SUBMITTALS

A. In accordance with the schedule given in this Section, the Subcontractor shall submit the following to the Contractor for approval in accordance with Section 01300.

1. Pilot-Scale Testing Work Plan and Design. The Pilot-Scale Testing Work Plan and Design prepared in accordance with Article 3.02 shall be submitted with the bid package. The Pilot-Scale Testing Work Plan shall describe implementation of in situ chemical oxidation and shall include a schedule for completion of pilot testing milestones. The plan shall address mobilization of Subcontractor equipment and personnel; site preparation and infrastructure needs; construction and installation of the delivery system; construction of temporary roads and facilities; installation of wells and/or injection points; operation of the system; oxidant (and associated reagent) application rates and pressures; operational and performance monitoring; system optimization; decontamination of equipment, and waste handling methods.

2. Conceptual Full-Scale Design. As part of the bid package, a conceptual design for full-scale implementation of in situ chemical oxidation treatment shall be submitted. The Conceptual Full-Scale Design shall be detailed enough to present the basis for the Full-Scale Option lump sum bid. This document shall clearly state all assumptions upon which the conceptual design is based (e.g., radius of influence, reaction rate, etc.), as well as how the results of the pilot scale test may potentially impact the full-scale design.

3. Safe Work Plan. A Safe Work Plan shall be submitted to the Contractor prior to mobilization of Subcontractor personnel to the site. The Safe Work Plan shall be revised as needed prior to full-scale fieldwork. Health and safety aspects of the entire project (pilot-and full-scale phases), including but not limited to the use of PPE, material handling and storage requirements, and job hazard analysis, shall be described in this plan. The Safe Work Plan shall

identify all potential hazards associated with the implementation of the treatment system and must follow the outline provided in the WSSRAP Health and Safety Plan which is included in these Subcontract documents.

4. Emergency Response Plan. An Emergency Response Plan shall be submitted to the Contractor prior to mobilization of the Subcontractor personnel to the site. The Emergency Response Plan shall be revised as needed prior to full-scale fieldwork. This plan shall describe procedures to be followed in the event of an emergency, and shall address medical emergencies, fires, explosions, spills and releases.

5. Sampling and Analysis Plan. Prepare and submit for approval a Sampling and Analysis Plan which addresses the Subcontractor's approach to monitoring the groundwater impact of the treatment process. The Plan shall include a sampling schedule for all locations to be sampled, and shall address methodology to be used for sample collection, preservation, handling, shipping, chain-of-custody, analytical test methods, quality control, and data reporting formats. The Sampling and Analysis Plan shall be submitted prior to conducting analytical sampling.

6. Analytical Laboratory Certification. The analytical testing laboratory qualifications and certifications shall be submitted to demonstrate that the laboratory is certified according to applicable RCRA regulations and qualified to perform the analytical testing required as part of the Work.

7. Interim Progress Reports. Prepare and submit Interim Progress Reports informing the Contractor of significant activities conducted as part of the Work. The reports shall be submitted monthly following the notice to proceed and shall contain a list of project milestones completed to date, as well as a look-ahead schedule to indicate upcoming activities.

8. Pilot-Scale Testing Completion Report. Upon completion of pilot-scale testing, prepare and submit a report describing all field activities performed as part of the pilot-scale testing program and present the testing results from this phase of treatment. The report shall contain all field and laboratory documentation generated during the project, including well installation logs, boring logs, chemical injection logs, field monitoring logs, and sample analytical results. The report shall discuss any unexpected conditions encountered in the field, as well as any subsequent modifications to the Pilot-Scale Work Plan and Design. The report shall include an evaluation of all data obtained during pilot-scale testing, particularly with respect to reaction rate, radius of influence, and efficiency of TCE destruction. This report will be evaluated by the Contractor and will provide a basis for whether or not to proceed to full-scale operations.

9. Final Full-Scale Work Plan and Design. The Final Full-Scale Work Plan and Design shall be submitted following the completion of pilot-scale testing and concurrent with analysis and documentation of the pilot-scale study. Following review of the pilot-scale testing results and final full-scale design, the Contractor may elect to proceed to full-scale implementation of in situ chemical oxidation treatment option. The plan shall refer to and incorporate the results of the pilot-scale testing and describe how these results affect the design of the full-scale treatment. The Final Full-Scale Work Plan and Design shall include the same elements that were addressed in the Pilot-Scale Work Plan and Design as they pertain to the full-scale system.

10. Full-Scale Completion Report. The Full-Scale Completion Report shall be submitted upon completion of full-scale treatment. The report shall describe all field activities performed as part of the full-scale Work. The results of the treatment process shall be presented. The report shall contain all field and laboratory documentation generated during the project, including well installation logs, boring logs, chemical injection logs, field monitoring logs, and sample analytical results. The report shall discuss any unexpected conditions encountered in the field, as well as any subsequent modifications to the Final Full-Scale Work Plan and Design. The report shall include an evaluation of the success of the treatment process, particularly with respect to final TCE concentrations achieved at the groundwater monitoring locations.

1.07 SUBMITTAL SCHEDULE

The following submittals are required in accordance with this specification.

Specification Reference	Submittal	Schedule
02050 (1.06.A.1)	Pilot-Scale Work Plan and Design	With bid package
02050 (1.06.A.2)	Conceptual Full-Scale Design	With bid package
02050 (1.06.A.3)	Safe Work Plan	15 days prior to performing field work
02050 (1.06.A.4)	Emergency Response Plan	15 days prior to performing field work
02050 (1.06.A.5)	Sampling and Analysis Plan	Prior to pilot-scale work. Revised as necessary prior to full-scale work.
02050 (1.06.A.6)	Analytical Laboratory Certification	Prior to pilot-scale work
02050 (1.06.A.7)	Interim Progress Report	Monthly after notice to proceed
02050 (1.06.A.8)	Pilot-Scale Testing Completion Report	Completion of pilot-scale testing
02050 (1.06.A.9)	Final Full-Scale Work Plan and Design	Completion of pilot-scale testing
02050 (1.06.A.10)	Full-Scale Completion Report (Contractor's option)	Completion of full-scale treatment

Specification Reference	Submittal	Schedule
02050 (1.08.A)	Registered Geologist License (copy) and resume	Prior to pilot-scale work

1.08 PERSONNEL QUALIFICATION

A. All work that involves characterization, testing, analysis, or interpretation of the geology or hydrogeology of the site shall be performed or directly supervised by a geologist registered in the State of Missouri. A copy of the registered geologist's resume and license shall be submitted to the Contractor for approval prior to starting work.

1.09 WITNESS AND HOLD POINTS

A. Contractor witness points are listed below:

1. During injection well or monitoring well installations.

2. During chemical reagent injection episodes.

B. Contractor hold points, including the estimated time needed for the Contractor to conduct the necessary review, inspections, sampling and tests, are listed below:

1. Pilot –Scale Work Plan and Design review and comment – 15 working days.

2. Safe Work Plan review and comment – 15 working days.

3. After installation of the pilot-scale system, prior to injection – 5 working days.

4. Pilot-Scale Test Completion Report – review and make a decision to proceed to full-scale – 15 working days.

5. Final Full-Scale Work Plan and Design review and comment, including a review meeting – 15 working days.

6. After installation of the full-scale system, prior to injection – 5 working days.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The materials used for the treatment system shall be chemically compatible with the oxidant used.

B. Oxidant chemicals and reagents shall be of a pure grade and be obtained from a reputable chemical supplier.

PART 3 - EXECUTION

3.01 GENERAL

A. The Subcontractor shall design, install, operate, and maintain an in situ chemical oxidation treatment system at the Chemical Plant site to remediate groundwater contaminated with TCE. Treatment shall focus on the shallow aquifer that includes the weathered upper portion of the Burlington-Keokuk Limestone and any saturated overburden material in the impacted area. The system shall treat the area of TCE impact where concentrations exceed an MCL of 5 μg/L.

B. The Subcontractor's pilot-scale and full-scale designs shall include containment systems in accordance with RCRA requirements. Static water testing of all tanks and storage units and hydro testing of delivery systems (pipes/hoses, tubing) shall also be included in the design and work plan for each phase of treatment.

C. The treatment system shall introduce the chemical oxidant into the full thickness of the weathered upper portion of the Burlington-Keokuk Limestone and within the zone of saturation. The concentration of oxidant and the rate of delivery shall be designed to deliver enough oxidant to satisfy both the TCE demand and the natural oxidant demand of the aquifer in order to preclude insufficient degradation of TCE and creation of undesirable reaction by-products.

D. The in situ treatment system shall be designed and operated in such a manner as to minimize eruptions or leakage of the oxidant chemicals. Injection of excessive amounts of residual reagent that may be discharged in the surface water at down-gradient springs shall be prevented. The Subcontractor shall clean up and containerize all soil waste generated by such a release as described in Section 01600.

E. The design should be based on treatment duration that is as short as possible (e.g. less than one year). The Subcontractor shall provide justification for the design treatment duration.

F. The Subcontractor shall define the reaction by-products and breakdown products that result from application of the treatment. In any case, by-products and breakdown products that create additional groundwater contamination (e.g., vinyl chloride, manganese, or hexavalent chromium), or significantly affect the aesthetic quality (color) for an extended period, are not allowed.

G. The operation of the in situ oxidation system shall not create reaction by-products (e.g. precipitated metal compounds) or residual reagent to a degree that will adversely affect the water chemistry or aquifer permeability (aquifer plugging) in a way that will make conventional water treatment more difficult.

H. Testing and operation of the treatment system shall not facilitate migration of TCE beyond the March 2001 defined limits of contamination.

I. Uranium, nitrate, and nitroaromatic contaminants are present in the subsurface environment. The Subcontractor shall account for their presence and chemical properties in the treatment system design. Long-term mobilization of these contaminants by the in situ chemical oxidation of TCE shall be prevented.

J. The level of impurities in the reagent shall not result in further contamination of the aquifer following injection.

K. The Subcontractor shall attend meetings with the Contractor as necessary to present progress reports and/or discuss immediate needs.

3.02 PILOT-SCALE WORK PLAN AND DESIGN

A. The Subcontractor shall prepare and submit a Pilot-Scale Work Plan and Design. The Work Plan and Design shall provide information and details on the pilot-scale testing, including test objectives, schematic diagram of the oxidant delivery system, location and layout design of the system, types and concentrations of chemicals to be used, oxidant mixing methods, injection technique, special contingencies, and performance monitoring.

B. The required oxidant concentration, introduction rate, and duration shall be determined by the Subcontractor from bench-scale testing performed previously and included in this Plan.

C. The Pilot-Scale Work Plan and Design shall include a conceptual design for full-scale implementation of the treatment system.

D. The Pilot-Scale Work Plan and Design submitted by the Subcontractor will be reviewed by the Contractor, the DOE, and regulatory agency(s). The review and comment process duration is 15 working days. The Subcontractor shall attend a Pilot-Scale Design review meeting on-site and revise the Work Plan and Design as needed and as directed prior to proceeding with the pilot-scale testing fieldwork.

3.03 PILOT-SCALE TESTING

A. The Subcontractor shall perform pilot-scale testing of the treatment system in accordance with the approved Pilot-Scale Work Plan and Design. The Subcontractor shall furnish, install, and operate the treatment system and appurtenances.

B. The Subcontractor shall perform pilot-scale testing at two locations selected by the Contractor within the TCE impact area to account for variations in aquifer permeability. One location shall be in the area of highest aquifer permeability and the other location in the area of lowest permeability so that best- and worst-case conditions can be evaluated. The Subcontractor may propose alternate locations.

C. The Subcontractor shall prepare a Pilot-Scale Testing Completion Report detailing the pilot-scale testing operations and resulting degree of success in reducing dissolved TCE in groundwater. The Contractor will use this report along with the final full-scale design and work plan as the basis for deciding whether or not to exercise the option to proceed with implementation and operation of a full-scale system.

3.04 FULL-SCALE WORK PLAN AND DESIGN

A. Upon approval by the Contractor, the Subcontractor shall prepare and submit a Final Full-Scale Work Plan and Design concurrent with the analysis and documentation of the pilot-scale study. The Work Plan shall incorporate the results of the pilot-scale testing and describe modifications to the Conceptual Full-Scale Design necessary for effective full-scale operation of the system. The same elements that are addressed in the Pilot-Scale Work Plan and Design for the pilot-scale testing shall be addressed in the Full-Scale Work Plan and Design as they pertain to the full-scale system.

B. The required oxidant concentration, introduction rate, and duration shall be determined by the Subcontractor from the pilot-scale testing, and shall be sufficient to treat the entire area of TCE impact and reduce groundwater concentrations of TCE to 5 µg/L. Results of the pilot-scale testing shall be used to determine the radius of influence achieved at each injection point. Full-scale treatment injection points shall be placed at optimal intervals to achieve full coverage of the TCE impact area without overdosing the aquifer.

C. The Full-Scale Work Plan and Design will be reviewed by the Contractor and off-site regulatory agencies. The review and comment process duration is fifteen working days. The Subcontractor must account for the review and comment period in the project schedule . The Subcontractor shall attend a Full-Scale Design review meeting and incorporate revisions as needed and as directed into the Work Plan and Design.

3.05 FULL-SCALE TREATMENT SYSTEM INSTALLATION

A. Upon review and approval of the Final Full-Scale Design and Work Plan, the Contractor may exercise the full-scale treatment option. The Subcontractor shall then furnish and install the treatment system and appurtenances in accordance with the approved Final Full-Scale Work Plan and Design.

3.06 FULL-SCALE TREATMENT SYSTEM OPERATION AND MAINTENANCE

A. The Subcontractor shall operate and maintain the treatment system for the duration of the treatment period.

B. The Subcontractor shall make modifications as needed to the design oxidant concentration, introduction rate, and duration during treatment system operation to optimize treatment and to prevent the migration of contaminants beyond the limits defined at the beginning of the pilot-scale treatment.

C. The Subcontractor shall provide a means for monitoring and controlling off-gas to comply with emission limits and worker exposure limits identified in the HASP.

D. The Subcontractor shall provide freeze protection for all exposed plumbing related to the treatment system.

3.07 GROUNDWATER MONITORING AND TESTING

A. The Subcontractor shall prepare and submit a Sampling and Analysis Plan (SAP) in conjunction with the Pilot and Full-Scale Work Plans for operation of the chemical oxidant delivery system. The SAP shall address the number and locations of groundwater monitoring points, frequency of monitoring, collection methods, preservation techniques, target compounds, analytical test methods and detection limits for the Subcontractor-performed sampling. Samples may be taken from the existing groundwater monitoring well system, or from new wells, probes, injection points, or other features installed for monitoring or as part of the delivery system prior to, during, and after operation of the treatment system. The Subcontractor is responsible for all handling and shipping of these samples in accordance with all state and federal requirements.

B. The Subcontractor shall monitor and document the rate, total volume, and concentration of the oxidant delivered, during and after operation of the treatment system to demonstrate that delivery is in accordance with the approved Work Plans. The Subcontractor may modify these parameters based on analytical test results in order to optimize performance of the treatment system. All modifications that deviate from the Work Plan shall be approved by the Contractor prior to implementation.

C. The Subcontractor shall measure groundwater levels in existing and new wells prior to, during, and after operation of the treatment system(s).

D. The Subcontractor shall monitor and document concentrations of off-gasses and other potentially hazardous conditions during operation of the treatment system. If necessary, the Subcontractor shall modify operations to avoid or mitigate the creation of hazardous conditions for workers and the environment.

3.08 EVALUATION OF THE EFFECTIVENESS OF TREATMENT

A. The Contractor will make the final determination of the effectiveness of the treatment of TCE based on Contractor-obtained and analyzed samples.

B. The Contractor will sample and analyze groundwater from the monitoring well network both prior to and following pilot-scale testing to track potential changes in TCE. The Contractor will also monitor groundwater prior to the full-scale treatment process to determine pretreatment baseline conditions, and during a 28-day period following each injection to evaluate the overall effects of the treatment process.

END OF SECTION 02050

Morrison Knudsen Corporation
Engineering, Construction & Environmental Group

WSSRA PROJECT REVIEWS AND APPROVALS

W.P. NO. 568 TASK NO. 541GW.900 DOC. NO. 3840-C:HG-S-05-4868-0A

W.P. TITLE: In Situ Chemical Oxidation of TCE in Groundwater

QUALITY LEVEL 2

LEAD DISCIPLINE Hydrogeology

SUBJECT: WSSRAP – Chemical Plant
Technical Specifications Section 02733
Well Installation and Abandonment

Issued for Review
Revision A

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SECTION 02733

WELL INSTALLATION

PART 1 - GENERAL

1.01 SCOPE

A. This Specification Section describes the requirements for:

1. Monitoring well installation
2. Injection well installation
3. Injection well abandonment

B. The work includes mobilization and demobilization of equipment; drilling and sampling; installation of monitoring and injection wells at both on-site and off-site locations, including well protection; packer testing; development of wells; abandonment of injection wells; site restoration; and equipment and personnel decontamination. This Specification shall be adhered to by the Subcontractor and lower-tier subcontractors for such operations.

C. All new wells shall be installed at locations previously staked by the Contractor's surveyor. Location coordinates and approximate depths shall be specified in the Work Plan for each phase of work (pilot- and full-scale).

D. The Subcontractor shall provide all equipment, supplies, materials, transportation, and labor needed to provide all services as described in this Specification. The Subcontractor shall be able to mobilize one additional crew with the equipment and training necessary for work at the WSSRAP in the event that one crew is already being utilized to capacity.

E. The Subcontractor shall be responsible for complying with any and all applicable boring, well installation, and well abandonment plans, permit requirements, and procedures. The Subcontractor shall comply with the State of Missouri Geologist Registration Act, 4 CSR 145. The Subcontractor shall comply with the State of Missouri Monitoring Well Construction Rules (10 CSR 23). The Subcontractor shall also comply with the Missouri Underground Injection Control Rules (10 CSR 50) as amended by waiver (if applicable). The Subcontractor shall submit for Contractor approval a copy of their State of Missouri well drilling license and drilling permit prior to Notice to Proceed.

1.02 RELATED WORK

A. Section 01503 – Equipment Decontamination

B. Section 01600 – Material Storage and Handling

C. Section 02050 – In Situ Chemical Oxidation

1.03 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Specification to the extent referenced using the most current version available at the time the work is awarded. The publications are referred to in the text by the basic designation only.

1. ASTM D1586 Standard Method for Penetration Test and Split-Barrel Sampling of Soils
2. ASTM D1587 Standard Practice for Thin-Walled Tube Sampling of Soils
3. ASTM D2113 Method for Diamond Core Drilling for Site Investigations
4. ASTM D2487 Standard Test Method for Classification of Soils for Engineering Purposes
5. ASTM D3550 Standard Practice for Ring-Lined Barrel Sampling in Soils
6. ASTM D4220 Standard Practices for Preserving and Transporting Soil Samples
7. U.S. EPA, *RCRA Groundwater Monitoring Technical Enforcement Guidance Document*, 1986
8. Missouri Department of Natural Resources' Division of Geology and Land Survey, *Missouri Well Construction Rules*, 10 CSR 23, June 1996.
9. EPA-570/975-001, *EPA Manual of Water Well Construction Practices*
10. EPA 600/489/034/1989, *Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*
11. U.S. Department of Interior, *Groundwater Manual*, A Water Resources Technical Publication, First Edition, 1977.
12. Missouri Geologist Registration Act, 4 CSR 145.
13. Applicable provisions of OSHA CFR 1910 and 1926.
14. Weldon Spring Site Remedial Action Project Health and Safety Plan, (most current version).

1.04 PROTECTION

A. The Subcontractor shall protect the following:

1. Benchmarks and monuments
2. Existing structures and fences
3. Monitoring wells
4. All areas outside of immediate work area
5. Existing features not part of this Work

1.05 SUBMITTALS

A. In accordance with the schedule given in this Section, the Subcontractor shall submit the following to the Contractor for approval in accordance with Section 01300.

1. Injection Well Plan detailing the location(s) and construction details for injection well(s).
2. Missouri Well Driller License (copy).
3. All documentation required to certify new monitoring and injection wells.
4. Daily Field Activity Report.
5. Field borehole logs, well construction diagrams, well development, and well abandonment forms.
6. Final typed borehole logs and as-built well diagrams.

1.06 SUBMITTAL SCHEDULE

The following submittals are required in accordance with this specification.

Specification Reference	Requirements	Period
02733 (1.01.E)	Missouri Well Driller License	Prior to Mobilization
02733 (1.05.A.1)	Injection Well Plan	30 days prior to installation
02733 (1.05.A.3)	All documentation required to certify new monitoring wells and injection wells.	14 days after completion of well installation
02733 (3.01.E)	Daily Field Activity Report	Daily upon commencement of work
02733 (3.09.A.2)	Field borehole logs, well construction diagrams, well development, and well abandonment forms.	Five working days after well completion or abandonment
02733 (3.09.A.2)	Final typed borehole logs and as-built well diagrams.	30 days after well completion.

1.07 PERSONNEL QUALIFICATIONS

A. The driller performing the work shall be a well driller licensed in the State of Missouri.

B. All drilling, well installations, and well abandonment shall be under the direct supervision of a geologist registered in the State of Missouri. Also see Section 02050.1.08.A.

1.08 SITE CONDITIONS

A. Stratigraphic Units and Soil Characteristics at the Weldon Spring Chemical Plant Site:

1. Bedrock:

a. The Burlington-Keokuk Limestone (Mississippian) comprises the uppermost bedrock stratigraphic unit at the Weldon Spring site. Because the Burlington-Keokuk Limestone was the only bedrock unit encountered during the previous investigations, it is the only unit discussed here. This unit is a thin to thick bedded, argillaceous, fine to coarsely crystalline limestone containing abundant chert as nodules and beds. On the basis of borehole stratigraphic data, the formation has been primarily divided into two sub-units according to the degree of weathering. The upper sub-unit is referred to as the weathered unit; the lower one is referred to as the unweathered unit.

1) The weathered unit is typically grayish orange to yellowish gray, and argillaceous. It contains up to 60% chert as nodules and interbeds. It is fossiliferous, moderately to highly fractured, and slightly to severely weathered. Solution features are common.

2) The unweathered unit is light gray, finely to coarsely crystalline, stylolitic, and fossiliferous, with less chert (20% - 40%) than the weathered limestone. This unit is much less fractured than the weathered limestone.

2. Overburden Soil:

a. Unconsolidated soil units overlying the limestone bedrock in the Weldon Spring site area are typically Pleistocene to Holocene glacial and periglacial sediments capped by a layer of organic topsoil. At the base of the sequence is the residuum, which has been interpreted as resulting from pre-Quaternary weathering of the youngest bedrock formation. The residuum is generally a reddish-brown gravelly clay to clayey gravel. Thickness and areal extent are variable.

1) The basal till (early Pleistocene) overlies the residuum. This unit is a yellowish-brown, sandy, clayey, silty gravel with angular chert pebbles in a loosely bound matrix. The thinness or absence of this unit in areas of high bedrock elevations suggests that the deposition of this unit may have been affected by bedrock topography. The basal till is found in the western and north central areas of the site.

2) The clay till unit overlies the basal till. This early Pleistocene deposit is composed of yellowish-brown silty clay to clayey silt. Clay till sediments are massive, very stiff, and moderately to highly plastic. Pebbles in the till are subrounded chert and igneous and metamorphic detritus in contrast with the coarse fraction of the basal till. This may indicate a different source area for the unit. The clay till is widely spread beneath the site.

3) Overlying the clay till is the Ferrelview Formation, a mid-Pleistocene glacial till plain sediment. This unit is a mottled gray and dark yellowish-orange silty clay to clayey silt. It is usually very stiff and plastic. This unit is also found throughout the site subsurface.

4) Overlying the Ferrelview Formation is a loess unit (late Pleistocene) that occurs sporadically across the site. The spotty distribution may be due to predepositional topography, post depositional erosion, and/or extensive reworking of the upper soils during site construction activities. The loess is primarily silt to clayey silt, with very minor amounts of sand, and has a low plasticity.

5) The uppermost soil unit is the combined topsoil/fill unit. The topsoil is generally a black, organically rich silt to silty clay. The fill fraction varies in thickness and composition across the site, but is primarily a clayey silt.

B. Trichloroethene (TCE) contamination in varying concentrations is present in groundwater at some locations.

1.09 PREPARATION

A. The Subcontractor shall be responsible for providing access to and construction of suitable drill pads as approved by the Contractor, as follows:

1. Depending on the location, access to some drill sites may involve the clearing of existing vegetation including shrubs and trees.

2. Because most of the work area is at final grade, the preparation of access roads from existing roads will involve only the placement of aggregate directly on the ground surface without any excavation. The aggregate used to construct

these temporary access roads and drill pads shall be clean material. Areas that require vegetation clearing may involve more earthwork to provide a suitable subgrade for the aggegate.

PART 2 - MATERIALS, EQUIPMENT, AND METHODS

2.01 MATERIALS

A. Lubricants: Only teflon tape or vegetable-based lubricants shall be used on the threads of downhole drilling equipment. Oils, greases, or pipe dope shall not be used on pipe threads, drilling rods, downhole hammer bits, or other downhole tools. Similarly, no hydrocarbon-based oils or greases shall be used on other open, lubricated surfaces of the drilling rig.

B. Antifreeze: If antifreeze is added to any pump, hose, etc., in an area in contact with drilling fluid, this antifreeze shall be completely purged and containerized for safe disposal and the system flushed by the Subcontractor prior to equipment use in drilling, mud mixing, or any other part of the overall drilling operation. Only polypropylene based antifreeze without rust inhibitors and/or sealants shall be used. The dates, equipment, quantities, and brand names of antifreeze shall be noted on the Daily Field Activity Report. An MSDS must be submitted and approved for antifreeze, and all other hazardous chemicals brought on site, per Section 3 of the WSSRAP Health and Safety Plan.

C. Drilling Fluids: Drilling operations shall be performed with no drilling fluids other than air or potable water without approval from the Contractor. The Subcontractor shall be responsible for providing hoses, tanks, and other equipment and transporting water to drilling locations. All tanks, hoses, and other water-handling equipment shall be decontaminated as specified in Article 3.10 of this Specification prior to commencing work. Hoses, valves, and other fittings shall be decontaminated between drilling locations. If bentonite-based drilling fluids are used, the bentonite shall be a certified sodium bentonite type.

D. Grout: Grout for well installation and/or abandonment shall be a bentonite slurry grout, a neat cement grout specifically designed for sealing subsurface openings, or an approved cement/bentonite grout mixture. The ratio of grout to fresh potable water shall be consistent with the manufacturer's instructions with respect to weights and measures and shall also comply with 10 CSR 23.

E. Potable Water: A potable water source will be supplied by the Contractor. The Subcontractor shall use potable water as needed to ensure that cuttings are removed from boreholes. Potable water must also be used for decontamination procedures as specified in Article 3.10.

F. Inert Gas: If packer testing is performed, the Subcontractor shall be prepared to supply inert gas as needed to properly and completely fill inflatable packers during packer testing.

G. Filter Sand: The Subcontractor shall be prepared to supply clean, uniform silica sand sized appropriate to the screen size, for use in well installation operations.

H. Well materials shall be compatible with the in situ chemical oxidation treatment process used.

I. Well materials shall be certified clean or decontaminated in accordance with Section 01503. Well casing, screens, and accessories shall be stored in a non-contaminated area, elevated off the ground, and covered with clean, new plastic sheeting. Any well casing, screens, or accessories that are subsequently contaminated by contact with the ground, blowing dust, or other potentially contaminated media, shall without exception be cleaned again prior to use.

2.02 DRILLING EQUIPMENT AND METHODS

A. All drilling and grouting equipment to be used in the work shall be clean and free of chemical or radioactive contamination. All equipment must be inspected and approved by the Contractor prior to entering the site.

B. The drilling method and equipment used during well installations shall be described in the appropriate Work Plan and approved by the Contractor. The following are requirements for common drilling methods previously used at the site:

1. Water Rotary: If water rotary ~~equip~~ment and methods are proposed, the Subcontractor shall:

   a. Use portable recirculation tanks. The use of dug sumps/pits (lined or unlined) is expressly prohibited.

   b. Perform drilling operations without the use of any additives.

2. Air Rotary: If air rotary equipment and methods (including reverse-circulation air rotary) are proposed, the Subcontractor shall:

   a. Specify the type and capacity of air compressor and lubricating oil to be used in the compressor, and retain a pint sample of each oil, along with a record of oil consumption on the boring log, for evaluation in the event of future problems.

   b. Use an air line oil filter maintained in accordance with Manufacturer's recommendations. This maintenance activity shall be recorded by the

Subcontractor on the boring log. Filter changes shall be done on a basis that is sufficient to eliminate oil from filtered air.

c. Perform drilling operations without the use of additives for bit lubrication and cuttings removal.

d. Fully describe, on the boring logs, air usage to include equipment description(s), manufacturer(s), model(s), air pressures used, frequency of oil filter change, and evaluations of the system performance.

e. Use a cuttings deflector shield or tube during operations to direct cuttings to a lined surface impoundment or a roll-off bin for containment.

3. Hollow-stem Augers: If hollow-stem auger equipment and methods are used, the Subcontractor shall use the appropriate-sized auger inner diameter to drill through the soil formations and allow installation of the well materials. The specific size of the hollow-stem auger shall be specified in the appropriate Work Plan.

4. Direct Push Method: If appropriate, the Subcontractor shall use direct-push equipment to place injection or monitoring wells. A Geoprobe® or equivalent system capable of sampling and installing wells to the required depths shall be utilized.

C. Drilling equipment shall be capable of drilling in clayey or granular soils and consolidated bedrock, above or below the water table. The Subcontractor shall maintain circulation with potable water and ensure that all cuttings are removed from the hole. Rig capabilities may be combined on a piece of equipment, or separate rigs with specialized functions may be used.

D. Packer Testing Equipment: If packer testing is performed, the packer testing method, equipment, and setup shall be approved by the Contractor prior to use.

E. Soil samples shall be collected when indicated in the Work Plan. Sampling methods and equipment shall be described in the Work Plan.

PART 3 - EXECUTION

3.01 GENERAL

A. The drilling, installation, and abandonment methods shall be described by the Subcontractor in detail in the appropriate Work Plan including, but not limited to, the type of equipment to be used and dimensions of bits, augers, and core barrels. The

methods proposed must be approved by the Contractor prior to starting field operations and must include techniques which:

1. Minimize subsurface contamination or cross-contamination.

2. Minimize waste generation in the form of drill cuttings or contaminated groundwater.

B. Drilling for monitoring and injection well installations shall avoid penetration into the unweathered portion of the Burlington-Keokuk Limestone to prevent downward migration of contaminants.

C. The Contractor will provide any applicable estimates of approximate overburden thickness, depth to unweathered portion of the Burlington-Keokuk Limestone, or other pertinent information to the Subcontractor.

D. The Subcontractor shall develop and submit to the Contractor for review and approval a Safe Work Plan as described in Section 02050 Article 1.06.A. The Safe Work Plan must follow the outline provided in the WSSRAP Health and Safety Plan which is included in these Subcontract documents.

E. The Subcontractor shall submit to the Contractor at the end of each day a Daily Field Activity Report covering all activities.

3.02 WELL CONSTRUCTION AND INSTALLATION

A. All wells shall comply with Missouri Well Construction Rules (10CSR23). Alternate designs or installation methods require approval in advance from the Contractor and from the Missouri Department of Natural Resources Division of Geology and Land Survey (MDNR-DGLS). Obtaining approval from the MDNR-DGLS shall be the responsibility of the Subcontractor and drilling subcontractor.

B. Equipment and tools to be used in the well construction shall be steam cleaned or high-pressure washed on a temporary on-site decontamination pad immediately prior to their use unless certified clean and sealed. Decontamination shall be performed in accordance with Article 3.11 and Section 01503.

C. All depths and thicknesses including total depth of hole, filter pack thickness, and depth to top of bentonite seal shall be checked and recorded by the Subcontractor geologist by use of a stainless steel weighted tape and verified by the Contractor. The depth of the well shall be sounded and recorded. The static water level in the well shall also be measured and recorded prior to and after well development. The Subcontractor geologist shall complete record forms in accordance with Article 3.10 of this Specification.

D. Protective surface casing, well cap, traffic barriers, and concrete pad shall be installed by the Subcontractor.

E. The Subcontractor shall submit a completed as-built well diagram to the Contractor and shall conform to all quality assurance requirements in Section 01400.

3.03 PACKER TESTING

A. If packer testing is performed, the testing shall be executed by isolating a drill hole interval, as specified in the Work Plan. Typical test intervals shall be provided in the Work Plan.

B. The Subcontractor is responsible for providing the appropriate equipment to perform packer testing. The packer testing configuration shall be approved by the Contractor.

C. Tests shall be conducted using either a single inflatable packer capable of achieving internal pressures necessary to completely seal the borehole. Water flow and pressure shall be monitored using a flow meter and pressure gauge, respectively. After a test section has been cored, the hole shall be flushed with potable water and the drill string will be removed. The packer assembly and associated piping shall be lowered and set at the interval to be tested and the packer shall be inflated with inert gas. After the packer is securely seated, the hole shall be pressurized with potable water to the desired pressure, allowed to stabilize, and the flow rate shall be monitored. Recording of monitoring data shall be the responsibility of the Subcontractor.

3.04 WELL DEVELOPMENT

A. The Subcontractor shall develop each well in accordance with Missouri State Regulations 10 CSR 23-4.0 and the following techniques and criteria unless a waiver is obtained from State regulators and the Contractor that is consistent with the drilling method and the use of the well. This development shall begin no sooner than 48 hours after installation is complete.

1. Development must be conducted using downhole pumps (hand operated or mechanically driven). The use of bailers must be approved by the Contractor. The use of air-lift methods for development is prohibited. All development equipment must be constructed of stainless steel, Teflon®, PVC, or tygon. No glues, solvent, pipe dope, or adhesive tape shall be used on any downhole equipment. The development technique shall utilize a large surge block periodically during the development cycle to properly develop the filter pack.

2. Static water levels must be measured using an electronic water level indicator.

3. A well volume shall consist of the water in the well casing and the hole annulus.

4. Development shall be considered complete when all of the following conditions have been met after removing at least three times the volume added during drilling and installation or three well volumes, whichever is greater.

   a. Three consecutive electrical conductivity measurements are stable within ±20%;

   b. Three consecutive pH measurements are stable within ±0.2 standard units;

   c. Three consecutive temperature measurements are stable within 1°;

   d. Three consecutive turbidity measurements are stable within 10% and below 100 NTUs. If these measurements do not stabilize and/or if the required amount of water is not removed, the Contractor must make a determination as to the completeness of the development.

   All well development parameters shall be recorded on the Monitoring Well Development Form (Attachment 4) throughout the development.

5. Development and purge water shall be dispositioned as described in Article 3.08 of this document.

6. The development of all wells must be approved by the Contractor. If this approval is not obtained, the Subcontractor shall, at his own expense, return to perform any work deemed necessary to properly complete the development.

3.05 PROTECTIVE CASING, GUARD POSTS, AND CONCRETE PAD

A. The Subcontractor shall provide and install a steel protective casing for each monitoring well and if necessary, each injection well. Other well protection means must be approved by the State regulators and the Contractor. Protective casings shall be a minimum of five feet in length and have an overlapping, locking cap. The protective casing and pad shall be installed prior to well development. Protective casings shall be anchored a minimum of three feet into the upper annulus by a concrete aggregate pad. The pad dimensions shall be two feet in diameter and shall extend three feet downhole. The pad shall be finished four inches above grade, with its surface sloping away from the protective casing (Figure 1).

B. Four guard posts shall be installed in a square pattern around each well. Each post shall be placed approximately three feet from the well and according to details shown in Figure 2.

C. In the event guard posts are not the best option, and only if directed by the Contractor, other forms of protection, such as jersey barriers, will be permitted.

3.06 CROSS-CONTAMINATION PREVENTION MEASURES

A. The Subcontractor shall at all times prevent the contamination or cross-contamination of all wells and borings. Prevention measures include appropriate drilling and well installation procedures and decontamination of drilling equipment and well screens and casing in accordance with Article 3.10 of this Specification. Potential contaminants include, but are not limited to, oils, greases, hydraulic fluids, fuels, and contaminated soils.

B. If the rig or any other equipment becomes contaminated due to equipment breakdown or the Subcontractor's negligence, decontamination shall be at the Subcontractor's expense. Drill bits, drilling rods, other downhole tools, and hand tools shall be decontaminated between boreholes. Any inadvertent introduction of contaminants to the borehole shall require the hole to be abandoned and replaced at the Subcontractor's expense.

C. Cross-contamination shall be minimized by thoroughly cleaning all external and internal surfaces of all drilling equipment, tools, drill bits, drilling stem, hoses, and all other pertinent equipment after each hole is completed and before moving to the next drilling location. Cleaning shall be accomplished by completely removing all soil from the equipment. Gross removal of soil can be performed at the drill site before moving.

D. During the performance period, the Subcontractor shall prevent soils and liquids from entering the borehole. Decontamination procedures for surface casings may be performed at the drilling locations.

3.07 COLLECTION AND DISPOSITION OF DRILL CUTTINGS

A. The Subcontractor shall dispose of any resultant cuttings as indicated by the Contractor. Upon direction by the Contractor, the Subcontractor shall spread uncontaminated cuttings in the immediate area of the well or collect contaminated cuttings in Subcontractor-provided containers and transport them to the Gate G staging area for disposition by the Contractor.

3.08 COLLECTION AND DISPOSITION OF DRILLING FLUIDS, DEVELOPMENT WATER, AND DECONTAMINATION WATER

A. The Subcontractor is responsible for collecting, containing, and, as necessary, treating of all wastewater produced during a drilling, development, or decontamination activity as directed by the Contractor. The Subcontractor shall collect potentially contaminated fluids and transport it to the Subcontractors water treatment area. The Subcontractor shall treat for residual reagent and store this water as described in Section 01600 3.03 and 3.04.

3.09 RECORD KEEPING, LOGS, AND OTHER DOCUMENTATION

A. Preparation of Drilling, Lithologic, and Abandonment Logs:

1. The Subcontractor shall supply a Contractor-approved geologist with each drill rig to prepare lithologic logs, well completion forms, well development forms, and well abandonment forms (see attachments for Subcontractor use or provide an equivalent). The minimum qualifications for geologist approval include a 4-year degree in geology or geological engineering and recent relevant experience in preparing lithologic logs in unconsolidated and consolidated materials. The geologist or geological engineer shall be responsible at each operating drill rig for the logging of samples, sample recovery, measurement of grout density, monitoring of drilling operations, recording of water losses/gains and groundwater data, preparing the boring logs and well construction diagrams, and recording the well installation procedures. Particular emphasis shall be placed on recording stratigraphic features and discontinuities that could affect contaminant or reagent transport and facilitate selection of screened intervals for monitoring and injection wells.

2. All depths and thicknesses, including total depth of the hole, filter pack thickness, and depth to top of bentonite seal, shall be checked and recorded by the Subcontractor and verified by the Contractor. Copies of field logs, well diagrams, and well abandonment forms shall be submitted to the Contractor within five working days of individual well completion or abandonment. Typed lithologic logs and as-built well completion diagrams shall be submitted within 30 calendar days of well installation completion.

B. Logbooks: The Subcontractor shall maintain a detailed logbook for all field activities. The logbooks shall be bound, shall have waterproof paper, and shall be completed using waterproof ink or marker. This logbook shall contain, at a minimum, a listing of all personnel at the sampling location and their affiliation; the time of arrival and departure from the site; each sampling location; personnel visiting and/or inspecting and/or auditing the sampling crews; accidents, unusual occurrences or observations; weather conditions; all water losses until development is achieved; and other relevant information necessary to allow a complete recreation of events. These logbooks shall be signed daily by the recording individual. All errors shall be deleted by a single strike mark through the error, with the initials of the person correcting the error, and the date by the strike mark. Copies of the logbooks shall be delivered to the Contractor upon completion of field work.

C. Completion of Daily Field Activity Reports and Other Documentation:

1. The Subcontractor shall complete a Daily Field Activity Report detailing the work performed on that particular date. These forms shall be signed daily by the Subcontractor's on-site supervisor and the Contractor.

2. Other documentation to be completed by the Subcontractor upon the completion of well installations are packer test forms (if packer testing is performed), and MDNR Certification forms.

3.10 EQUIPMENT DECONTAMINATION PROCEDURES

A. All coring, sampling, augering, and other drilling equipment and tools used by the Subcontractor shall be decontaminated by hot water steam cleaning and air drying after mobilization, prior to use on-site, between installations and abandonments, and prior to demobilization. The Subcontractor shall perform decontamination of the above-mentioned equipment at an on-site, Subcontractor-constructed, temporary decontamination pad. Subcontractor-supplied decontamination equipment shall receive a safety inspection by the Contractor prior to use.

B. All decontamination fluids shall be collected and treated as described in Article 3.08. All solid decontamination materials (i.e., rags, brushes, loose soil, PPE, etc.) shall be collected, packaged or containerized, and delivered to a disposal area as directed by the Contractor.

C. Screens and casing, including protective casing, shall be decontaminated using a high-pressure steam cleaner, unless wrapped in plastic or otherwise covered and accompanied by the manufacturer's certification of decontamination prior to installation. The Subcontractor shall supply all equipment, including a high-pressure steam cleaner and materials necessary to perform adequate decontamination procedures.

3.11 INJECTION WELL ABANDONMENT

A. The injection wells to be abandoned and all drilled holes that do not receive permanent monitoring equipment shall be abandoned in compliance with Missouri State Regulations 10 CSR 23.

B. All casing material and associated hardware (i.e., caps, plugs, riser pipe, centralizers), filter pack, annular seal, protective casing including concrete pad, and protective posts shall be removed during abandonment. The Contractor must be notified if any material cannot be removed prior to plugging the hole. The well casings, concrete, and rubble shall be taken to an off-site disposal location after approval is received from the Contractor.

C. Where it has been determined that removal of the well materials is impractical, the Subcontractor shall present options and obtain concurrence from the Contractor on the selected option prior to contacting the State regulators to request a variance.

D. Drilling shall be concentric to the casing to ensure removal of all well construction material and loose unconsolidated/consolidated material.

E. To ensure removal of all well construction material, the hole shall be reamed at a minimum of the original hole diameter.

F. After monitoring equipment (screen and/or riser casing) has been removed (leaving an open hole), the hole must be grouted simultaneously with casing removal to prevent hole collapse. If the well cannot be abandoned in one day, the Subcontractor shall cap the hole with the rig and drill stem to maintain the integrity of the hole.

G. The preferred abandonment method shall be to tremie-place a bentonite slurry grout specifically designed for sealing boreholes to the ground surface. Any other 10 CSR 23 approved grout method may be used with Contractor prior approval. The grout shall be mixed according to the manufacturer's specifications. If bentonite grout is used, the ratio of clay grout to fresh potable water must achieve a weight of at least 9.4 pounds/gallon. The grout shall be mixed by jetting through the hopper and circulated through the rig's mud pump and tremied with a positive displacement pump. This ratio shall be verified and properly documented by the Subcontractor in the field using a mud balance. Native topsoil shall be applied at the surface to a depth of approximately two feet.

H. As an option to the rig's pump, the Subcontractor may also use a portable grout mixer or pump for the mixing and placing of grout by tremie pipe into the well boreholes.

I. Where complete removal of steel casings is required and unlikely to be achieved by overdrilling and pulling on the casing, a hydraulic casing cutter shall be used. This method shall be pre-approved by the Contractor and described in the Work Plan submitted. The cutter shall be lowered into the hole to a depth specified by the PMC representative and the casing shall be cut. The cutter shall be retrieved and the casing below the cut line grouted as outlined above. The steel casing above the cut line shall then be removed as outlined above.

3.12 COMPLETION

A. Site Restoration: The Subcontractor shall be responsible for site cleanup and restoration not provided by the Contractor and required as a result of activities associated with this Specification. This shall include:

1. Immediate measures to prevent erosion resulting from Subcontractor activity.

2. Removal of all work-derived trash and debris.

3. Repairing of any damaged structures or fences.

END OF SECTION 02733

ATTACHMENT 1

Borehole Log for Soil

PMC INSERT

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES DIVISION

BOREHOLE LOG

Sheet _____ of _____
Project Number:
Hole Number

Project:
Location:
Drilling Contractor:
Coordinates:
Depth Top of Rock:
Depth Casing & Size:
Hole Size:
Drill Make and Model:
Angle from Vert. and Bearing:
Depth Bottom of Hole:
Elevation:
Date Start:
Date Finish:
Logger:
Water Level:
Fluid & Additives:

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE & NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS: 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION: Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol

ATTACHMENT 2

Borehole Log for Rock Cores

PMC INSERT

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet _____ of _____

Project Number:

BOREHOLE LOG

Hole Number

Project:	Location:		
Coordinates:	Drilling Contractor:		
Drill Make and Model:	Depth Top of Rock:	Depth Casing & Size:	Hole Size:
Elevation:	Angle from Vert. and Bearing:	Depth Bottom of Hole:	
Water Level:	Fluid & Additives:	Date Start:	Date Finish:	Logger:

DEPTH	COMMENTS: TESTS/MONITORING INSTRUMENTATION CORING RATE AND SMOOTHNESS CORING FLUID LOSS CONTAMINATION	CORE RUN LENGTH AND RECOVERY (%)	CORE LOSS ZONE	BOX NUMBER	DISCONTINUITIES: ROD	DISCONTINUITIES: FRACTURES PER FOOT	DISCONTINUITIES: DESCRIPTION TIGHTNESS PLANARITY SMOOTHNESS FILLING, STAINING ORIENTATION	GRAPHIC LOG	LITHOLOGY: MINERALOGY CLASSIFICATION COLOR GRAIN SIZE ALTERATION	LITHOLOGY: CEMENTATION HARDNESS WEATHERED STATE

ATTACHMENT 3

Monitoring Well Installation Diagram

PMC INSERT

WELDON SPRING SITE REMEDIAL ACTION PROJECT
MONITORING WELL INSTALLATION DIAGRAM

PROJECT NAME _____ WORK PACKAGE NO. _____

WELL NO _____ WELL LOCATION _____

DATE _____ TIME _____ COORDINATES N: _____ E: _____

GROUND SURFACE ELEVATION _____

TOP OF SCREEN ELEVATION _____

REFERENCE POINT ELEVATION _____

TYPE FILTER PACK _____ GRADATION _____

FILTER PACK MANUFACTURER _____

SCREEN MATERIAL _____

MANUFACTURER _____

SCREEN DIAMETER _____ SLOT SIZE _____

RISER MATERIAL _____

MANUFACTURER _____

RISER DIAMETER _____

DRILLING TECHNIQUE _____

AUGER/BIT SIZE AND TYPE _____

BENTONITE TYPE _____

MANUFACTURER _____

GROUT TYPE _____

MANUFACTURER _____

GROUT WEIGHT _____

BOREHOLE DIAMETER _____

FIELD REPRESENTATIVE _____

DRILLING CONTRACTOR _____

AMOUNT BENTONITE USED _____

AMOUNT CEMENT USED _____

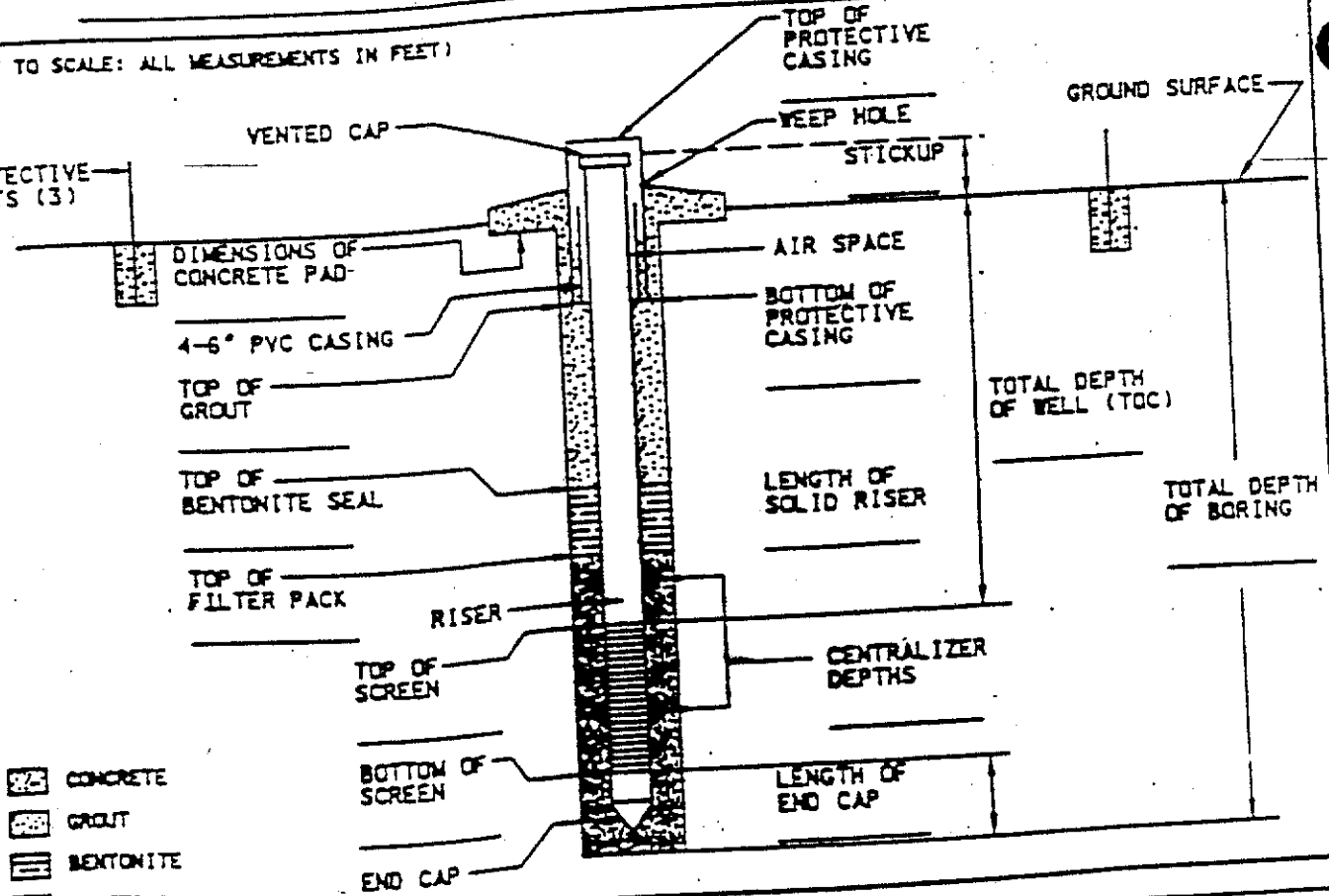
AMOUNT SAND USED _____

STATIC WATER LEVEL (> 24 hrs. after dev.) _____

MEASURED ON (date/time) _____

REMARKS _____

(NOT TO SCALE: ALL MEASUREMENTS IN FEET)



QA/QC

DRILLER: _____ INSPECTOR: _____

DISCREPANCIES: _____ CHECKED BY: _____ DATE: _____

A/P1/052/0495
04/03/95

ATTACHMENT 4

Monitoring Well Development Form

PMC INSERT

WELDON SPRING SITE REMEDIAL ACTION PROJECT

MONITORING WELL DEVELOPMENT FORM

ES&H 4.4.8.2, Rev. 1, 7/96

PROJECT NAME _____ WORK PACKAGE NO. _____ SHEET 1 OF 2

DEVELOPED BY _____ Well Location: _____

1. Well Number.: _____
2. Date of Installation: _____
3. Date of Development: _____
4. Static Water Level: Before Development _____ ft.; At least 24 hrs. after _____ ft.
5. Organic Vapor: Before development _____ ppm; After development _____ ppm.
6. Quantity of water loss during drilling, if used: ____ gal.
7. Quantity of standing water in well and annulus before development: _____ gal.
8. Depth from top of well casing to bottom of well: _____ ft. (from Well Installation Diagram)
9. Well diameter: _____ in.
10. Screen length: _____ ft.
11. Minimum quantity of water to be removed: _____ gal.
12. Depth to top of sediment: Before development _____ ft.; After development _____ ft.
13. Physical character of water (before/after development): _____
14. Type and size of well development equipment:
15. Description of surge technique: _____

_____

16. Height of well casing above ground surface: _____ ft. (from Well Installation Diagram).

Quantity of water removed: _____ gal. Time for removal: _____ hr./min.

ATTACHMENT 5

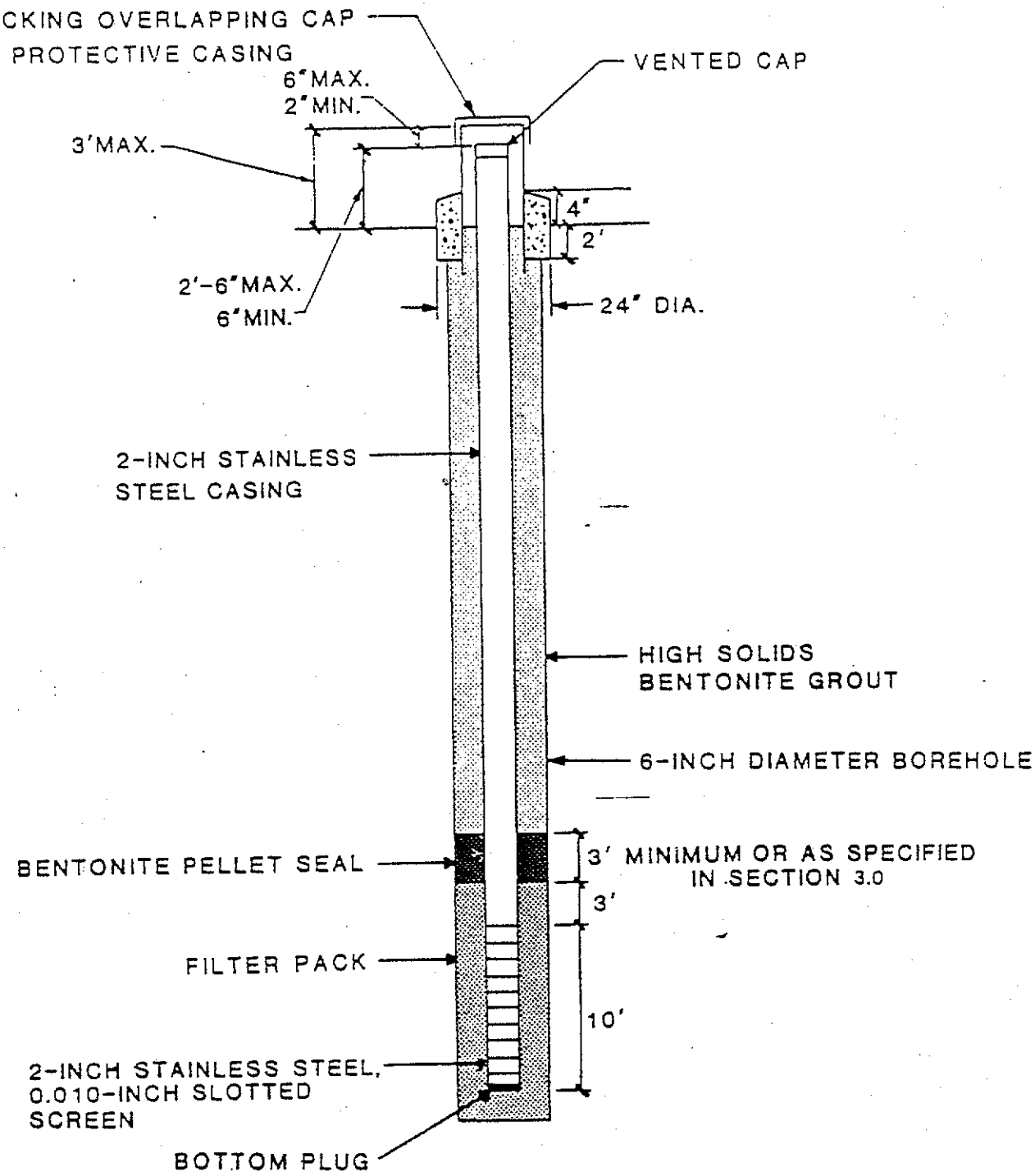
Well Abandonment Form

PMC INSERT

FIGURE 1

Typical Monitoring Well Construction

PMC INSERT THIS FIGURE



NOTE: THIS FIGURE DEPICTS A TYPICAL 2' STAINLESS STEEL MONITORING WELL. SOME DIMENSIONS AND MATERIALS MAY VARY AS THE SPECIFICATION ALLOWS.

NOT TO SCALE

TYPICAL MONITORING WELL CONSTRUCTION

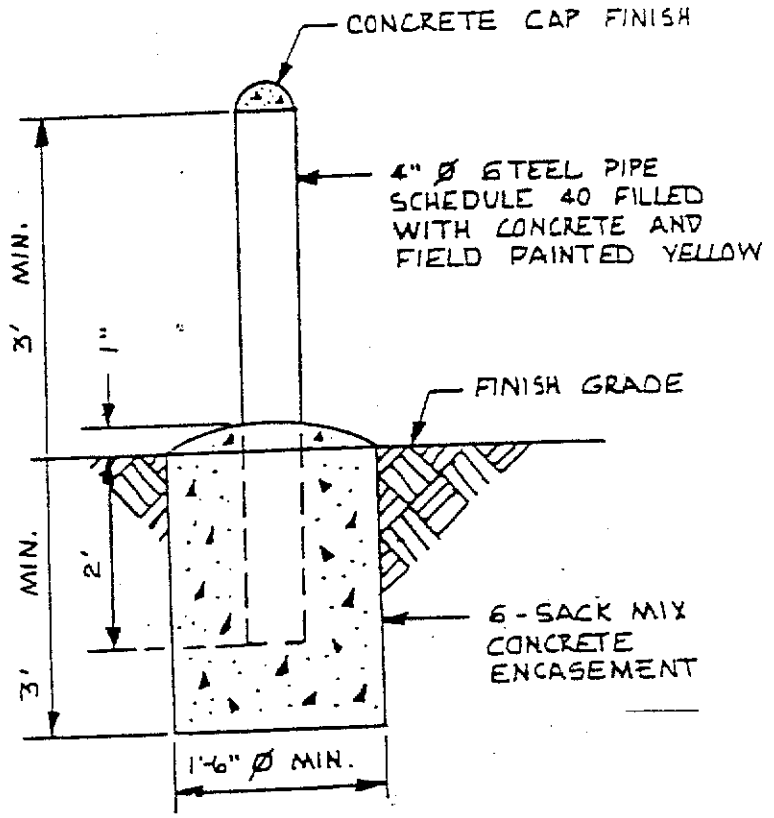
FIGURE 3

REPORT NO.: WP-487		DRAWING NO.: A/PI/216/1191	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 6/11/97	

FIGURE 2

Typical Guard Post

PMC INSERT THIS FIGURE



NOT TO SCALE

GUARD POST

FIGURE 4

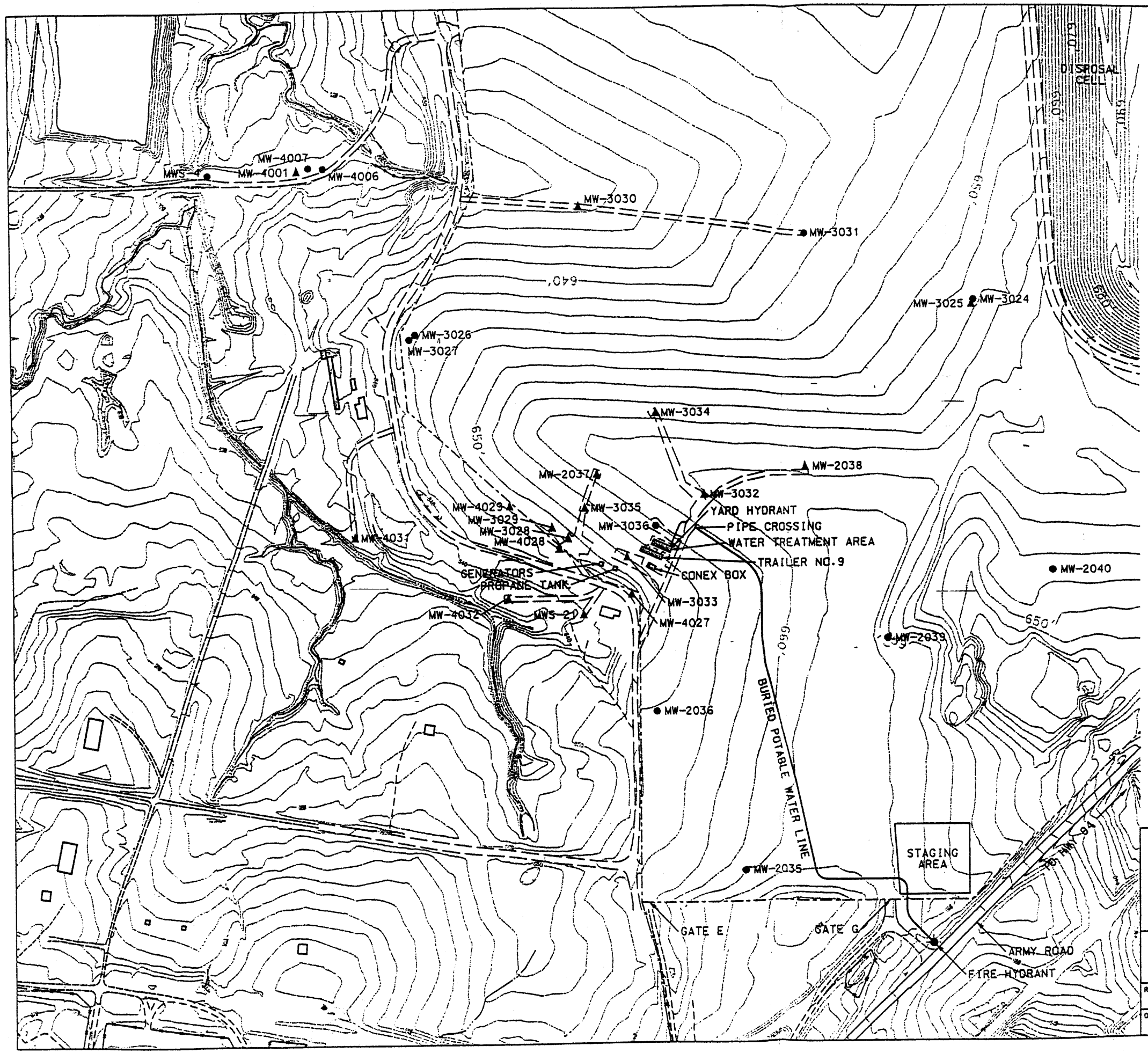
REPORT NO.: WP-487		DRAWING NO.: A/PI/217/1191	
ORIGINATOR: SDG	DRAWN BY: GLN	DATE: 1/24/95	

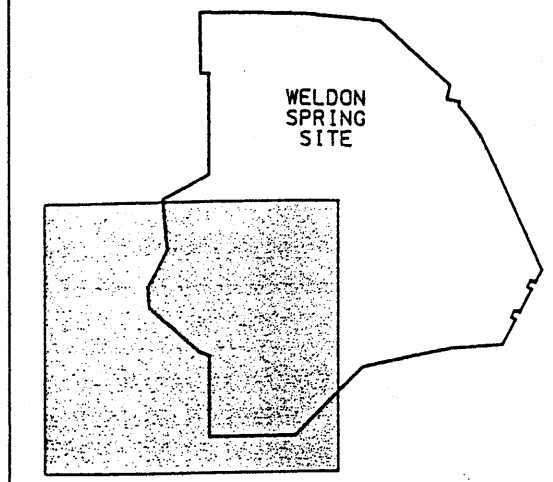
SUBMITTAL CHECKLIST - WP 568 Rev. A
In Situ Chemical Oxidation of TCE in Groundwater

Notes:

1. The submittals listed below do not relieve the Subcontractor of submitting any information required by the terms and conditions of the Subcontract that is not listed.
2. Items underlined are not required to be on a submittal form. These items can be transmitted by letter or given directly to the Construction Engineer.

DELIVER TO:	REFERENCE SECTION	DESCRIPTION/ DELIVERABLE	SUBCONTRACTOR SUBMITTED	COMMENTS	Date Submitted	Date Returned
GENERAL PROVISIONS						
ENGR	GP-4	Shop drawings.	Timely manner to support project.	Mandatory approval.		
CM&O	GP-11	Invoices and payments.	By the 15th of each calendar month.	Properly completed invoice in duplicate.		
ENGR	GP-27	Material Safety Data Sheets.	5 working days prior to bringing materials on site.	See Health and Safety Plan.		
CM&O	GP-29	Temporary Buildings & Utilities.	Timely manner prior to need.	Mandatory approval.		
PROC	GP-74	Substance Abuse Program.	Within 10 days of contract award.	Mandatory approval.		
PROC	GP-75	Certificate of insurance.	7 days after award.	Mandatory approval.		
GENERAL CONDITIONS						
ENGR	GC-2	As-built drawings.	Prior to final payment.	Mandatory approval.		
ENGR	GC-3	Construction schedule.	Submit Construction Schedule within ten days after Notice of Award.	Mandatory approval.		
ENGR	GC-3	Schedule of Values	Prior to receiving notice to proceed.	Mandatory approval		
CM&O	GC-3	Monthly schedule analysis and update.	By 15 of each month.	Mandatory approval. Submit with Progress Payment Request.		
ENGR	GC-7	Lower tier subcontracts.	Within 30 days after award and prior to subtier arrival on-site.	Mandatory approval. Furnish list of references.		
PROC	GC-8	Labor and equipment rates.	Within 15 days after award.	Mandatory approval.		
CM&O	GC-9	Daily construction report form.	Daily.	Mandatory approval.		
PROC	GC-10	Weekly man-hour report/employee roster form.	Weekly.	Mandatory approval.		
CM&O	GC-11	Overtime Request.	48 Hours in Advance.	Mandatory approval.		





LOCATION MAP

N

LEGEND

▲ – MONITORING WELL WITH WITH ≥ 1 ug/l TCE

● – OTHER MONITORING WELL

– GRAVEL ROAD

0 250 500

SCALE FEET

LAYOUT OF THE GENERAL TCE WORK AREA

FIGURE 1

REPORT NO.: WP-5[illegible]0 SPEC 01500		EXHIBIT NO.:	B/CP/039/0401
ORIGINATOR: B[illegible]D	DRAWN BY: GLN	DATE:	5/4/01